## Subject index

accidents, nuclear 163, 164, 169  
accounting regulation 45, 53  
administrative procedures 33, 41–2  
Africa 68  
   North 64–7, 71, 82–3  
   West 67, 71, 83  
agricultural wastes 207  
Algeria 65, 66, 71, 101  
   GECF 72, 73  
   Skikda liquefaction plant 74  
anaerobic bacteria 213–14  
Angola 67, 71  
AREVA 122, 124, 129, 140–1, 143, 144  
Argentina 97–8  
Arun, Indonesia 96, 102  
Asia 12–13  
   Central 69  
   see also under individual countries  
Atlantic Basin  
   emerging LNG market in 76–9  
GECF 72, 73  
Atomic Energy Canada Ltd (AECL) 174, 176  
Azerbaijan 70  
Baker Institute World Gas Trade Model (BIWGTM) 92–103  
Baltic states 172, 178–85  
battery electric vehicles (BEVs) 249–50, 271, 275–6  
Belarus 59, 62, 74, 81  
biofuels 192, 260, 275–6  
biological processes 207  
hydrogen production 212–14  
biological water-gas shift reaction 213  
biomass 192, 207–8, 215, 216  
hydrogen production 210–11, 212–14, 235  
biophotolysis 212–13  
bipolar electrolyser 208  
Blue Banana region 243–5  
Bolivia 97  
Brazil 97, 103  
British Energy 146, 152, 155, 159, 161, 164  
financial crisis 155, 156–8, 162  
risk management strategies 162, 163  
share price 156, 157  
British Gas 10  
Bulgaria 177  
buses, hydrogen 255, 278  
byproduct hydrogen 234, 235–6, 253  
CAFE policies 263–4  
California  
   energy crisis of 2000–2001 25, 26–8, 51  
   zero emission programme 251  
Canada 76–7  
CANDU-6 nuclear technology 174–5  
capacity credit 202  
carbon capture and storage (CCS) technology 19, 111, 193, 259, 263, 271  
carbon dioxide emissions 84–5, 199  
   reduction target 261  
   see also greenhouse gas emissions  
carbon dioxide price risk 124–5, 143–4  
cartels 300  
   gas 4, 72–3, 100–101, 257  
cash-flow analysis 241–3  
Caspian region 70–71, 82  
catastrophe risk 163, 164  
Central Asia 69  
   Central Europe 11, 18, 110, 171  
Centrica 10  
Cernavoda power plant complex 174, 175–6  
Chernobyl disaster 164, 179
Security of energy supply in Europe

Chicago cold snap 25, 26, 27
Chile 97–8
China 12
LNG imports 79–81
Cities Alliance 40
climate change 4, 167
see also carbon dioxide emissions; greenhouse gas emissions
climate policy 109–10
hydrogen transition and 248–74
natural gas and 6, 19
coil 85, 110–11, 160
hydrogen production from 193, 196, 234
security of supply to Europe and 256, 257, 258–9, 271
collaboration between gas exporters
73, 84
see also Gas Exporting Countries Forum (GECF)
combined-cycle gas turbine (CCGT) plants 121, 124, 131
combustible hydrogen resources 252–3
combustion 207
‘Commodities Clause’ 33, 43–4
commodity markets 160–1
common carriage (TPA) 33, 34–7
Commonwealth of Independent States (CIS) 59, 69
competition
natural gas 6
global competition for LNG supplies 76–81
US and European gas pipelines 21–55
and security of supply 6
policy enforcement 296, 300–1
public policies facilitating competition 296, 300
compressed gaseous hydrogen 236, 237–8, 239
concentrated-user scenario 225, 230, 231, 233, 241
concentrating solar thermal systems 203–4
consortia 122, 126, 128–9
of consumers 139–42, 148–9
of producers 137, 146, 148
Constellation Energy 139
construction risk 118, 121–3, 137, 140–1, 144, 148
consumers’ cooperative 139–42, 148–9
continental Europe 11–12
contracts 99
gas pipelines and 21, 23, 24, 48–9, 99, 301
nuclear power 161–2
compatibility with financing arrangements 127–35
contractual arrangements and new nuclear investment 117–54
risk management 161–2
contractual congestion 51
cooperative, consumers’ 139–42, 148–9
corn 160
corporate finance 112, 118–19, 127, 129–32, 141, 144, 147, 148
costs
cost of capital 132–5, 147–9
cost efficiency of FCEVs 266–70
of hydrogen 239–41
sharing in a consortium 146
credit rating 133–4
damless hydropower 205
dark fermentation 213–14
debt finance 128
decentralized markets 136–42, 148
delivered gas era 24–5
demand
hydrogen demand rollout 229–30, 231
natural gas 5
development in Russia 63–4
uncertainty 4
Department of Energy (DOE) (USA)
hydrogen technology goals 279–80
progress reports 280
R&D funding 281–2
comparison with the EU 287–8
derivatives markets 160, 161
direct biophotolysis 212–13
distributed-user scenario 225, 233, 241
diversification
of gas supply 8, 17–18, 63, 101–2
of portfolios 126–7, 130
dual hydrogen supply 239
Subject index

| Eastern Europe 11, 18, 110, 171 | European Defence Community 166 |
| Nuclear investment 145, 146 | European Economic Community (EEC) 166 |
| Eco-efficiency 261–6 | European Emissions Trading Scheme 109 |
| Economic risk 111–12 | European gas pipeline network 21–2, 23, 24, 29, 30–2, 48–50 |
| Electricity 298 | European spatial structure 243–5 |
| Competition between hydrogen and gas markets 103 | ‘European Strategy for Sustainable, Competitive and Secure Energy’ (Green Paper) 8, 60, 114–15 |
| Meaning of a liberalized market 159–61 | Enlargement of markets 296, 300 |
| Regulation 111 | Facility incidents 73–4 |
| From renewables 192, 199–200, 202 | European Energy Charter Treaty 11, 60, 81 |
| Electricity companies 134–5 | Energy policy goals 178 |
| Electricity forward agreement (EFA) market 161 | EU–Russia Energy Dialogue 17, 60–1, 81 |
| Electricity prices and British Energy’s financial crisis 157–8 | Integrated energy and climate policy 248 |
| Lithuania 181–2 | Transition to hydrogen and nuclear energy see nuclear energy |
| Electrolysers 208–10, 216 | R&D efforts in hydrogen 283–7 |
| Electrolysis 193, 208–10, 235 | Comparison with USA 287–8 |
| Electro-motor 249 | Second Gas Directive 11, 35–6, 39, 40, 42, 45 |
| ENEL 144, 145 | European Atomic Energy Community (Euratom) 166–7 |
| Energy Charter Treaty 11, 60, 81 | European Commission 8, 40–1, 44–6, 60, 114–15 |
| Energy crops 207 | Compatibility with contractual arrangements 127–35 |
| Energy efficiency | Federal Energy Regulatory Commission (FERC) 21, 24, 41, 42, 43, 44–5, 46–7, 49 |
| Hydrogen transport 253–5 | Federal guarantees 123, 137–9 |
| Policy 298–9 | Federal Trade Commission (FTC) 37 |
| Energy mix 114–15 | Fennovoima 142, 152 |
| Energy policy, EU 178, 248–74 | Finance |
| Energy storage see storage of energy | Gas pipelines 24–5, 42 |
| Energy Watch Group 258 | New nuclear build 112, 117–54 |
| Enlargement of markets 296, 300 | Case studies 135–49 |
| Environment | Compatibility with contractual arrangements 127–35 |
| Eco-efficiency and transition to hydrogen 261–6 | Impact of hydrogen production from renewables 214–15 |
| See also climate change | E.ON 144, 145, 146 |
| E.ON 144, 145, 146 | Equatorial Guinea 67, 71 |
| Estonia 178, 184 | Equity investment 128–9, 132–3 |
| European Atomic Energy Community (Euratom) 166–7 | European Commission 8, 40–1, 44–6, 60, 114–15 |
heat, from hydrogen 223
heavy water 174–5
Henry Hub 25, 26, 28
Hepburn Amendment 34–5, 43
High Level Group (HLG) on hydrogen and fuel cells 285
high-temperature electrolysis systems 209–10
holding companies 37–8
hurricane season of 2005 25, 28, 51
hybrid electric vehicles (HEVs) 249, 271
hybrid financing approaches 118, 127, 131–2
hydroelectricity 205–6, 215, 216
hydrogen 191–8
competition between electricity and 215
early transit road network 230, 231
early-user centres 224–5, 230, 231
end uses 194–5
deployment of end-use applications 222–4
EU member state visions of hydrogen sources 226–9
infrastructure 193–4, 216–17
build-up in Europe 221–47
production 192–3
primary energy basis 252–3
production mix 232–6
way forward 289
R&D 195–6, 275–92
from renewables see renewables
security of supply 255–61
transition
determinants of 277–9
and EU energy and climate policy goals 248–74
transport see fuel cell electric vehicles (FCEVs); transport hydrogenase 212
hydropower 204–6, 215, 260
HyWays project 221–2, 224, 254
Ignalina nuclear reactor 179–85
import dependence
gas 56, 58–9
security and 73–5
uranium 167
incremental pricing 46, 47, 53
India 12
LNG imports 70, 79–81
indirect biophotolysis 213
Indonesia 13, 78, 84, 96, 102
Industry Grouping (IG) 286–7
infrastructure
failure 81–2
hydrogen 193–4, 216–17, 221–47
investment
gas 8, 91–2, 103
hydrogen 239–41
institutions
gas pipelines
central role 22–3
institutional divide in US and European pipeline networks 29–47
institutional arrangements and nuclear new build 136–49
integrated gasification combined cycle (IGCC) 211
integrated global gas market see global gas market
Interconnector pipeline 29, 31, 74
intermittency 192, 199–200, 202
internal combustion vehicles (ICVs) 250, 267, 268
International Energy Agency (IEA) 58, 61–2, 63, 64–7, 92, 121, 222, 223
Interstate Commerce Commission (ICC) 34–5
investment
gas security investments in liberalized markets 75–6
infrastructure
gas 8, 91–2, 103
hydrogen 239–41
in new gas fields 63
nuclear new build 117–54
investor confidence 102
investor–owners 33, 34
Iran 65, 66, 69–70, 72, 81, 94
LNG project 70
Iraq 70
Italy 73, 76, 96–7, 99, 167–8, 232
Japan 12, 91, 96, 251
Joint Technology Initiative for Fuel Cells and Hydrogen (JTI) 250, 286–7, 288
Security of energy supply in Europe

Kazakhstan 70
Korea, North 173
Korea, South 12, 91
Krishna Godavari Basin 80

Latvia 178, 184
lead-times for nuclear build 121
learning costs 122–3, 137–8
liberalized markets
  contractual and financing
    arrangements for new nuclear
    investment 117–54
  electricity markets 159–61
  gas 10–11
  nuclear power in the UK 155–65
Libya 65, 66, 71
Lietuvos Energija 182, 183–4
life-cycle assessment (LCA) 214–15
liquefaction of biomass 207
liquefied natural gas (LNG) 11, 12,
  16–17, 75, 91, 103, 257
Asian countries 12–13
  China and India 79–81
Atlantic Basin 76–9
GECF 72, 73
global competition for LNG
  supplies 57, 76–81
government role in global gas
  market 96
West African exports 67, 83
liquid hydrogen 194
tuck deliveries 236, 237, 238–9
Lisbon Agenda 4
Lisbon Treaty 166
Lithuania
  National Energy Strategy 180,
    181–3, 185
  nuclear energy 172, 178–85
  treaty of accession to the EU
    179–80
loan guarantees 138–9
loan instruments 42
local politics 102–3
local pollutants 264–5, 266
local-use scenarios 229–30
long-distance road scenario 229–30
long-term contracts
  gas pipelines 21, 23, 36–7, 47,
    301
  nuclear energy 125, 138
Magnox Electric 156
Malaysia 13
market risks 118, 124–7, 138, 141,
  143–4, 148
markets
  commodity markets 160–1
  hydrogen and 278, 291
  R&D 289
natural gas 6, 9
  integrated global gas market see
global gas market
  interconnectedness 8, 18
  modelling 14–15
  new market structures 95–100
  regional approaches to security
    9–13
niche 278
nuclear power and liberalized
  markets
  contractual and financing
    arrangements for new
    investment 117–54
UK 155–65
related 278
and security of supply
  centrality of markets 296, 299
  public policies facilitating
    enlargement of markets 296,
    300
wider markets 296, 299–300
merchant model for nuclear new build
  136–9, 148
mergers 300–1
Mexico 76–7
Middle East 13, 64–7, 67, 68, 69–71,
  82, 94
mineraiads 173
minimum efficient scale (MES) of
capacity 161
Mobil Corporation 96
Moldova 69
monopolies
  natural 22, 50
  public utilities 23, 49
MOREHyS model 226
municipal wastes 207
Nabucco pipeline 70
National Power 160
natural gas see gas, natural
natural monopolies 22, 50
Netherlands, the 58, 185–6
network effects 196
networks, open-access pan-European 295, 298
new build nuclear power 112
contractual and financing arrangements 117–54
niche markets 278
Nigeria 67, 68, 71
NIMBY (‘not in my back yard’) syndrome 298
nitrate oxides 263
non-combustible hydrogen resources 252–3
Nordpool 186
Nordstream pipeline 62
Norpipe 29, 30
North Africa 64–7, 71, 82–3
North American gas market 76–7
Norway 58, 85
NRG Energy STP 137–9
Nuclear Electric 156
nuclear energy 109–16, 200 characteristics 158–9
context 110–11
in the EU 166–88
current situation 167–8
diversity of member state opinions 110
in the EU-15 168–70
fifty-year history 166–8
new member states 170–86
nuclear renaissance 109–10
European Commission 2006 Green Paper 114–15
fuel security and the nuclear fuel cycle 112–13
future nuclear energy systems 113
hydrogen production from 193, 234, 235
EU security of supply and 259
new build contractual and financing arrangements 117–54
and the supply chain 112
nuclear plant ownership and credit rating 133–4
regulation 111–12, 120–1
UK 112, 121, 145, 146, 155–65, 169
nuclear fuel cycle 112–13
nuclear fusion 113, 196
nuclear weapons 114, 175
Nuclearelectrica 174, 176
OECD 67, 68–9
prices 268, 269, 270
security of supply to Europe 256, 257–8
US oil pipeline system 38, 48
Okiluoto III project 140–2, 148
onsite hydrogen production technology 235, 236
open-access pan-European networks 295, 298
operating leverage 158–9
operating risk 118, 123–4
Orenburg pipeline system 29
overlapping jurisdictions 39–41
ownership separation 18, 33, 43–4
Oxford Institute for Energy Studies (OIES) 58
Pacific Basin 78, 79
Pakistan 80, 81
pan-European networks, open-access 295, 298
particulate matter (PM) 263–5
penetration scenarios for hydrogen vehicles 222, 223, 229
performance risk 118, 123–4, 137, 140–1
Petrobras 97
photo-electrochemical decomposition of water 204
photofermentation 213
photoheterotrophic bacteria 213
photovoltaic (PV) cells 202–3, 214
pipelines
gas 7, 36–7
China 80, 81
India 80–1
Middle East/Caspian region 70–1
North Africa 71
regulation 15, 15–16, 18, 21–55
hydrogen 194, 236, 237, 239
plug-in-hybrid electric vehicles (PHEVs) 195, 200, 249, 250, 271
Security of energy supply in Europe

Poland 97, 99, 103, 182, 184, 185
policy
climate policy see climate policy
energy policy 178, 248–74
roadmaps 115
and security of supply 296, 298–9
bad policy and the long term 296, 301
political risk 118, 120–1, 140, 143
portfolio bidding 126–7, 130
portfolio diversification 126–7, 130
PowerGen 160
price risk 161–2
Priority Interconnection Plan (PIP) 18
private carriers 33, 34–7
private commercial players 98–100
privately funded research 282–3
privatization 33
production tax credit (PTC) 123, 137–8
project financing 112, 118, 127, 129–32, 138–9, 147, 148
project management 122
property rights 33, 46–7
property value 33, 41–2
proton exchange membrane (PEM) fuel cells 208–9, 222
public utility holding companies 37–8
public utility monopolies 23, 49
Putin government 60, 68–9
PVC 160
PVO 140
pyrolysis 210–11
Qatar 65, 66, 69, 72, 96
reaction turbines 205
RECLUS 243
regulation
gas 15, 15–16, 18, 21–55
institutional divide in US and European pipeline networks 29–47
nuclear power 111–12, 120–1
regulatory risk 118, 120–1, 138, 140, 143
relearning costs 122–3, 137–8
renewables 109–10, 178, 192
energy sources 201–8
EU security of supply 259–61
hydrogen from 199–220, 234, 235, 252–3
environmental impact 214–15
production technologies 208–14
storage problem 195, 200
rents, regulation of 33, 46–7
reprocessing of nuclear fuel 113
research and development (R&D) into hydrogen 195–6, 275–92
comparison of EU and USA 287–8
EU 283–7
needs 277
USA 279–83
Research Grouping (RG) 287
resilience 8–9
resource nationalism 67–8
restructuring 3–4
risk management 161
strategies for nuclear power 161–2, 163
risk premium 147
risks
in new nuclear investment 117–18
mitigating or shifting away from investors 119–27, 149
nuclear power and 162–4
see also under individual types of risk
Romag-Prod facility 174–5
Romania 172–8
Rome Treaties 166
Rough storage facility 74, 75
Russia
Energy Strategy 63
gas exports 11, 12, 16, 67, 68, 68–9, 101, 171
energy policy see energy policy
EU–Russia Energy Dialogue 17, 60–1, 81
GEFC 4, 72, 100–1, 257
global gas market 94
LNG 77–8
long term 82
pipeline to Poland 97, 99
short term 81
supplies after Ukraine crisis 59–64
Lithuania and energy dependence on 180–1
RWE 144, 145, 146
safety regulation 111, 120–1
Saudi Arabia 66–7, 94
Scottish Nuclear 156
Scully Capital 131–2
seasonal storage 7
secondary trading 9, 46, 47
Securities and Exchange Commission (SEC) 37, 39
segmenting of capacity 46
SEMO 186
Shell International 68
short term
disequilibria 295, 296
and gas supply security 5, 7
new security environment for gas 81–2
silicon wafers 203
single regulatory authority 33, 39–41
Sixth Framework Programme (FP6) 283–5
‘Snapshot 2020’ 286, 287
Societatea Nationala Nuclearelectrica (SNN) 176
solar energy 202–4, 214, 234, 235, 260
solid polymer electrolyte (SPE) electrolyser 208–9
Solid State Energy Conversion Alliance (SECA) 288
solidarity between EU member states 295, 297
South-Eastern Europe 18
South Stream Gas Pipeline 62
South Texas Project (STP) 136–9, 148
Soviet Union 178–9
see also Russia
Spain 96–7
special purpose entities (SPEs) 127, 130–1
Standard Oil Company 34–5
storage of energy
hydrogen 191–2, 200, 223–4, 267, 281
natural gas 7, 18
investment in 75–6
problem and renewables 195, 200
strategic reserves, management of 301
subsidies
hydrogen R&D 283, 289
nuclear new build 123
Sucursala Cercetari Nucleare (SCN) 174
Suez-Electrabel 144, 145
sunk costs 99
sustainability 6
Sweden 169, 182, 184
TAP pipeline project 80
tariff regulation/administration 33, 41–2
technology policy 299
thermal dissociation of water 193, 211
thermochemical processes 207
hydrogen production 210–11
third party access (TPA) obligations 33, 34–7
3M Company 281
tidal power 205
tidal stream power 205
Trans Europa Naturgas Pipeline (TENP) 29
Transelectrica 174
Trans-European Network (TEN) 18
Transgas pipeline system 29, 30, 98, 99
transit incidents 73–4
Trans-Mediterranean (Transmed) Pipeline 29, 30, 74, 96–7
transparency 8–9
information about gas pipelines 33, 44–6
transport
gas see pipelines
of hydrogen 193–4, 236–9, 246
using hydrogen as fuel 191, 192, 194–5, 222–3
case for 275–6
hydrogen transition and goals of
EU energy and climate policy 248–74
infrastructure analysis 224–46
see also fuel cell electric vehicles (FCEVs)
Trinidad 77, 99
tuck transport of hydrogen 236, 237–9
Turkmenistan 70, 80
turnkey contracts 122–3, 129, 140–1
Ukraine 62, 69, 81
gas crisis with Russia 56, 59, 60, 74, 171

François Lévêque, Jean-Michel Glachant, Julián Barquín, Christian von Hirschhausen, Franziska Holz and William J. Nuttall - 9781849806961
Downloaded from Elgar Online at 09/01/2019 01:58:58AM via free access
unconventional gas reserves 77
unipolar electrolyser 208
United Kingdom (UK)
  Energy Act 1983 164
  and EU energy policy goals 178
gas 5
  declining production 58
  pipeline system 49
  restructured markets 10–11
  security incidents 74
Nuclear Installations Act 1965 164
nuclear power 112, 169
  investment 121, 145, 146
  liberalized market 155–65
United States of America (USA)
Administrative Procedures Act 1946 41–2
Department of Energy see Department of Energy (DOE)
development of transport policy 250–1
gas 5, 94
  CCGT plant bankruptcies 131
  competition with EU 11
growth of the pipeline network 23–5
independence of gas and oil markets 25, 26
institutional divide between US and European pipeline networks 29–47
LNG 76–8
market and stress 25–8
MENA gas exports 66
regulation 16, 21–55
restructured markets 10
secondary trading 9, 46, 47
Holding Company Act 1935 37–8, 39
hydrogen R&D efforts 279–83
  comparison with the EU 287–8
Interstate Commerce Act 1887 36
  Hepburn Amendment 1906 34–5, 43
Natural Gas Act 1938 40
nuclear power 159, 164
  new build investment 136–9, 148
Price-Anderson Act 1957 164
uranium 259
Uranium National Company (UNC) 174
Venezuela 72
vertical integration
gas pipelines 23, 24, 38–9
  nuclear new build 117, 126–7, 132, 142–6, 148
volatile organic compounds 263
waste, nuclear 112–13, 120, 158–9, 169, 175
water
electrolytic hydrogen production 193, 208–10, 235
  photo-electrochemical decomposition of 204
thermal dissociation of 193, 211
water-gas shift reaction, biological 213
water turbines 205, 206
waterwheels 205
wave power 205
weighted average cost of capital (WACC) 133, 134
West Africa 67, 71, 83
wind energy 201–2, 214, 216, 234, 235, 260, 261
World Gas Model (WGM) 14
Yamal Peninsula 63
zero emission program 251